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ABSTRACT

Forty-five lesson plans in geometry are presented which incorporate career education into the ordinary ninth-tenth grade geometry curriculum. The lessons focus on one or more of the following developmental areas of career education: self knowledge, individual and environment, world of work, economics, education and training, employability and work adjustment skills, and decision making. Each lesson identifies an instructional and developmental goal and gives performance objectives, activities, and resource materials. For example, in lesson 3 (parallelism and perpendicularity), the instructional goal is to recognize and be able to define parallel, perpendicular, and skew lines, while the developmental goal is to know why city planners use parallel and perpendicular streets in contrast to other arrangements in downtown areas. Some of the suggested activities are, in addition to having students construct parallel and perpendicular lines with a compass and straightedge, to look at a map of city streets and see parallel and perpendicular arrangements, and to have students set up criteria for downtown street arrangement and compare different possibilities. It is also suggested that a civil engineer could discuss what goes into city planning of street arrangement. (BB)

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CAREER EXPLORATION 9 – 10

LESSONS IN CAREER EDUCATION
FOR USE IN
GEOMETRY

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BULLETIN #728

September 1975

CAREER DEVELOPMENT K – 10

CINCINNATI PUBLIC SCHOOLS

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OE 015 429

ACKNOWLEDGMENTS

This bulletin was originally written in the summer of 1975 by the teachers named below as an activity of the Career Education Program of the Cincinnati Public Schools. They were advised by Wayne Minnich, Instructional Consultant in Career Education, Jerome Braun and Roy Matthews, Instructional Consultants in Mathematics. The project was carried out under the general direction of Marlyn Bray, Coordinator of Career Education and Ralph Shauck, Coordinator of Instructional Resources.

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During the summer of 1976, Charles Staley of Schwab, Sharleen Gist of Western Hills, and Firmin Widmer of Eastern Hills revised the manual. They were assisted by Roy Matthews, Instructional Consultant in Mathematics. The project was carried out under the general direction of the Career Staff and Ralph Shauck, Coordinator of Instructional Services.

Approved:

James Jacobs	Raymond J. Brokamp
Superintendent of Schools	Assistant Superintendent

As the incorporation of career planning increases in the Cincinnati Public Schools' curriculum, so should the teachers' awareness of how to implement these concepts into their instructional goals. Teachers are encouraged to read these lesson plans and attempt to use them at the appropriate time during the year. It is hoped that teachers will begin to stress the practical applications of their daily lessons in the areas of employment. Teachers should use student oriented activities and bring in outside resources to illustrate the relevance of specific topics whenever possible.

Any teacher who has found a technique or specific lesson plan which has been successful in relating their specific academic area to a career field is asked to share this with the rest of the system. This may be done by outlining the activity and sending it to the Mathematics Office at the Education Center.

SEVEN DEVELOPMENTAL AREAS

Listed below are the seven developmental areas of Career Education. Research has taught us that career development starts in early childhood and continues throughout life. Thus, the seven developmental areas represent a broad sphere in which learning can take place starting at the kindergarten level and reaching to the senior level.

SELF

Students develop knowledge pertaining to attitudes, feelings, perceptions and evaluation of self.

INDIVIDUAL AND ENVIRONMENT

Students develop insights into how environments keep people producing, why people work, the relationship between the individual and work, and how people use and modify environments and their resources.

WORLD OF WORK

The content includes the nature of work, the scope and nature of occupations, methods of studying and classifying occupations and perceptions related to work values.

ECONOMICS

Students develop an understanding of the economic process. This process involves employing human needs. This component enphasizes both the earning of income as a worker and the disposition of income as a consumer.

EDUCATION AND TRAINING

This component is designed to assist the student in developing an awareness of the relationship between education and training and the life roles assumed by oneself and others.

EMPLOYABILITY AND WORK ADJUSTMENT SKILLS

This component is designed to help students develop those patterns of behavior necessary to enter, maintain and progress in a career. The importance of the development of successful attitude strategies is a vital part of this component.

DECISION MAKING

Decision making is, in reality, not a separate component, but a PROCESS that encompasses all of the developmental areas. Students should practice making decisions. They need to gather facts about themselves, jobs, and values, and how to weigh information to reach a conslusion as to what work they are able to do and what work they want to do.

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I.

SUBJECT: Geometry

INSTRUCTIONAL TOPIC: Metric System

DEVELOPMENTAL AREA: All Developmental Areas

INSTRUCTIONAL GOAL: to show the students the need, simplicity, and uniformity in adopting the metric system of measurement in the United States.

DEVELOPMENTAL GOAL: to have the students come to the realization that the implementation of the metric system of measurement will alter and improve all aspects of their lives.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. List five prefixes the metric system has that the English system does not have. 2. List five occupations which presently use the metric system. 3. List three advantages the United States will gain in adopting the metric system of measurement. 4. List the necessary steps any company will do in converting entirely to the metric system.	1. Have groups of students picture themselves isolated on an island and in need of developing a means of measurement of length, weight, volume, temperature, area, time. 2. Have each group defend their choice of measuring system. 3. Discuss the following: a. Why do you like or dislike the metric system? b. Are you able to accept change; e.g., do you change your wardrobe to meet the current styles? c. How will the metric system change your everyday lives? d. Who will find the conversion easier: adults, school-age children, or pre-school age children?	1. W.C.E.T. metric programs. 2. Cassette/filmstrips on the metric system. 3. Consult the science teacher.

I.

Metric System (continued)

Performance Objective	Activities	Resource Materials
	e. Will the schools play a big role in this change? f. Will this conversion change a worker's job? g. Will this conversion effect your choice of career fields to enter? 4. Discuss the feasibility and effect a worldwide monetary system or universal language would have.	

II.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Points and Lines

DEVELOPMENTAL AREA: Decision Making, World of Work

INSTRUCTIONAL GOAL: to understand that point and line are the basis of geometry and the whole concept of shapes, forms, and sizes.

DEVELOPMENTAL GOAL: to understand the importance of points and lines in everyday functions of life - medical technology, recreation (billboards), measurement, computers (programming, logic), etc.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. State definitions of some geometric figures and recognize the dependence of those definitions on the concept of point & line. 2. Discuss how these basic concepts influence daily life, technology, and recreation.	1. Do problems similar to those on page 5. 2. Give students a list of recreational activities, various technologies, etc., & let them suggest ways in which the concepts of point and line are used. 3. Give a separate topic from the above to a group of four to five students with one person acting as recorder. Discuss the topic as a class. Example: in the field of X-Ray Technology, one must be able to pinpoint the specific area of tissue which is to be exposed to the radiation. This involves precise measurement & the concept of a straight line (X-Ray beam).	1. Straightedge. 2. Examples of activity areas: a. radiologist b. city planner c. athletic director d. astronomer e. baseball player f. billiard player g. highway patrolman

II.

Points and Lines (continued)

Performance Objective	Activities	Resource Materials
	4. Have each student lay out an athletic field and determine how points and lines play an important part in various sports played there by drawing.	

III.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Parallelism and Perpendicularity

DEVELOPMENTAL AREA: Decision Making, Individual & Environment

INSTRUCTIONAL GOAL: to recognize and be able to define parallel, perpendicular and skew lines.

DEVELOPMENTAL GOAL: to know why city planners use parallel and perpendicular streets in contrast to other arrangements in downtown areas.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Define conditions which are required for parallel, perpendicular & skew lines. 2. Construct and draw perpendicular, skew and parallel lines. 3. Give reasons why parallel and perpendicular arrangement of streets is more advantageous than any other in city planning.	1. Have students work a few "traditional" problems recognizing parallel, skew and perpendicular lines form a worksheet. 2. Have students construct parallel and perpendicular lines using a compass and a straightedge, or using a carpenter's square. (See illustration which follows). 3. Identify the parallel and perpendicular streets in the area of your school. 4. Look at a map of city streets and see parallel and perpendicular arrangements. 5. Have groups of students set up criteria for downtown street arrangement & compare different possibilities. Share results with class.	1. Compass 2. Straightedge 3. City map 4. Carpenter's square 5. Speaker (civil engineer) to discuss what goes into city planning of street arrangement.

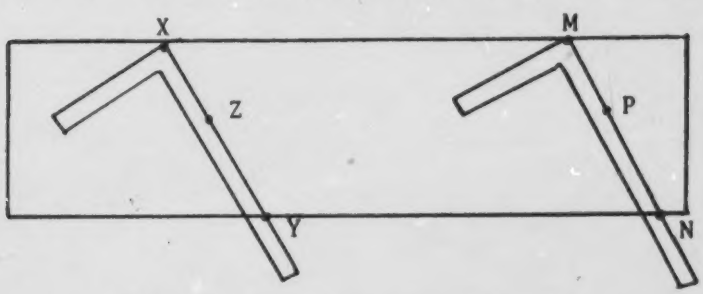
III.

Parallelism and Perpendicularity (continued)

Performance Objective	Activities	Resource Materials
	6. Discuss what jobs are involved in city planning.	
	7. Role play in groups the planning of a new city where students use their own criteria for the design. Each group can then compare their designs.	
	8. Discuss examples of other cities which do or don't use the parallel/perpendicular plan such as Boston or Denver. Those students who have done travelling may be able to add other examples.	

ILLUSTRATION OF ACTIVITY 2

Construct A Parallel Line Using a Carpenter's Square



1. Set carpenter's square so that the difference between the two edges of the board is $\overline{XY}$. Mark midpoint Z of $\overline{XY}$.
2. Move carpenter's square so that $\overline{MN} \cong \overline{XY}$. Mark midpoint P of MN.
3. Connect points Z and P.
4. $\overline{ZP}$ will be parallel to $\overline{XM}$ and $\overline{YN}$.

IV.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Parallel Lines

DEVELOPMENTAL AREA: Individual & Environment

INSTRUCTIONAL GOAL: to introduce parallel lines and to discuss their role in sports.

DEVELOPMENTAL GOAL: to show how the student might use parallel lines in sports.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Give examples of parallel lines in the classroom. 2. Give examples of parallel lines in sports.	1. Introduce parallel lines from text, page 147. 2. Discuss & write on the board examples of parallel lines in the classroom. 3. Write many examples of parallel lines in sports: a. parallel bars b. parallel lanes in swim meet. c. layout of tennis courts, football field, etc. d. skiing - ski-jumping, body parallel to ground. 4. Form groups and see which group has most at the end of five minutes.	1. Text: Modern School Mathematics; Houghton-Mifflin.

V.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Locus of Points

DEVELOPMENTAL AREA: Decision Making, Education & Training, Self

INSTRUCTIONAL GOAL: to understand the concept of locus of points and be able to describe circles, ellipses, parabolas and hyperbolas in locus terms.

DEVELOPMENTAL GOAL: to realize what prerequisites are necessary in various careers and how locus of points is a similar idea.

Performance Objective

The student should be able to:

1. Understand the general definition of the locus of points and the specific case of the circle.

2. Sketch and describe several given loci.

3. Construct the loci of the ellipse, parabola, & hyperbola.

4. Discuss some specific conditions (prerequisites) that must be met before various career goals are realized.

Activities

1. Use problems on page 441.

2. Have students draw the loci of the ellipse, by using a piece of string and realize how it verifies the definition of the ellipse, page 455. (See activity on drawing ellipses.)

3. Have students construct the parabola and the hyperbola by paper folding and realize how both figures verify their definitions, page 455. (See activity on paper folding.)

4. Use the definition of locus of points; namely, "a locus of points is a geometric figure containing all points, and only those points which satisfy given conditions," to expand the idea of career choices. Give

Resource Materials

1. Textbook: Holt Geometry.

2. String, about 10" long.

3. Graph paper (4 units per inch.

4. Corrugated cardboard.

5. Thumb tacks.

6. Worksheets listing 10 to 15 career choices.

7. College and/or technical school bulletins.

8. Compass.

9. Training paper.

10. Jacobs: Mathematics A Human Endeavor
W. H. Freeman Co., pp. 249-252, 262-263, 270-271.

V.

Locus of Points (continued)

Performance Objective	Activities	Resource Materials
	students 10 - 15 career choices & have them list what prerequisites of training would be necessary to reach each career goal. a. Career choices should range from simple to highly technical. b. Students may work in groups of 4 or 5 on the entire list of careers, ranking them in order of "least technical" and then list the prerequisites that must be met for each. c. Students then compare their ideas with other groups in a class discussion.	

VI.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Congruent Angles and Parallel Lines

DEVELOPMENTAL AREA: Decision Making

INSTRUCTIONAL GOAL: to show the student that two parallel lines cut by a transversal form congruent corresponding angles and congruent alternate interior angles.

DEVELOPMENTAL GOAL: to show the student the relationship between factual information and good decision making habits.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Draw the conclusion that given two parallel lines cut by a transversal, the alternate interior angles are congruent. 2. Draw the conclusion that given two parallel lines cut by a transversal, corresponding angles are congruent. 3. Draw the conclusion that given two parallel lines cut by a transversal, interior angles on the same side of the transversal are supplementary. 4. Draw the conclusion that given two parallel lines cut by a transversal, alternate exterior angles are congruent. 5. List some of the factors which go into wise decision making & some factors which interfere with wise decision making.	1. Have students work some elementary problems dealing with the properties of parallel lines. 2. Find the measure of the angles formed by two parallel lines cut by a transversal, given the measure of one of the angles. 3. Have students examine the decision making processes they used in activity #2. 4. Have a classroom discussion concerning traits of wise decision makers. 5. Have students rank a list of occupations according to the amount of decision making necessary. 6. Have students do Prob. #21, p.79, Holt Geometry.	1. List of 15 occupations to be ranked for activity #5.

VII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Construction of Perpendicular Lines

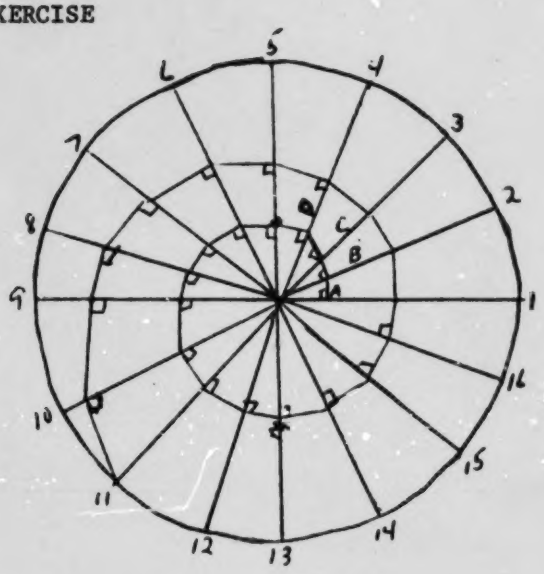
DEVELOPMENTAL AREA: Individual & Environment

INSTRUCTIONAL GOAL: to teach the student how to construct the perpendicular at a point on a line.

DEVELOPMENTAL GOAL: to make the student aware that geometry surrounds us in nature.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Construct perpendicular lines with compass and straight edge. 2. Name three examples of spirals in nature.	1. Do in text: p.416, #1, #9. 2. Do the special exercise on the next page to illustrate how this construction can be used in design. 3. Coordinate with algebra by use of the Fibonacci Sequence. 4. Show how this applies to forms in nature: tornadoes, whirlpools, the chambered nautilus, a sea animal, etc.	1. Text: Houghton-Mifflin; Modern School Mathematics. 2. Applications in Mathematics by Johnson, et.al., Pub. Scott Foresman. 3. Holt contemporary algebra with trig. 4. Film, "Donald Duck in Mathemagic Land."

* SPECIAL EXERCISE



1. Draw a circle ○ 16 radii equally spaced such that all central ∠s are ≅ .
2. Number each radius.
3. Label pt A on radius #1.
4. Construct a ⊥ at pt. A and extend this ⊥ until it intersects radius #2. Label this pt. B on radius #2.
5. Construct a ⊥ at B and extend it until it intersects radius #3 at C.
6. Continue this pattern until it reaches the circle.

VIII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Construction of Rectangles

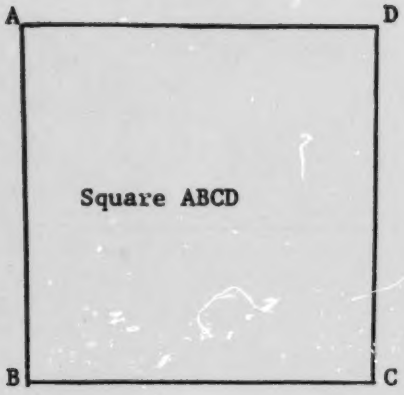
DEVELOPMENTAL AREA: Individual & Environment

INSTRUCTIONAL GOAL: to learn some basic construction techniques and basic ideas about the rectangle.

DEVELOPMENTAL GOAL: to appreciate the beauty of geometry as it appears in art, architecture and the environment.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Name the basic parts of a rectangle. 2. Construct a midpoint, perpendicular, and use a compass to make arcs. 3. Appreciate the use of the Golden Rectangle in art, architecture.	1. Answer questions about rectangles and squares, p.241-242, text. 2. Construct a Golden Rectangle (attached worksheet). 3. Divide a Golden Rectangle into squares & draw a spiral in it. 4. Find examples of the Golden Rectangle in art and architecture.	1. Text: Houghton-Mifflin, Modern School Mathematics. 2. Applications in Mathematics, Johnson, et.al., Scott Foresman and Company. 3. Film, "Donald Duck in Mathemagic Land."

WORKSHEET

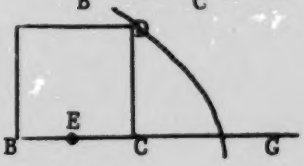


START

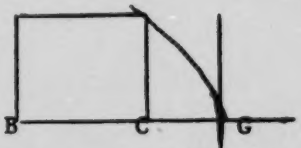
Find the midpoint of BC. Label it E.

Extend BC to the right.

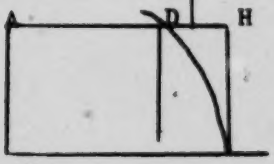
With E as center and ED as radius, draw an arc to line BC. Label point G.



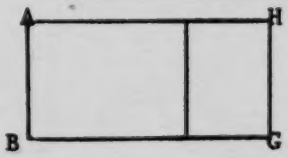
Construct a line perpendicular to BC at G.



Extend AD until it meets this line. Label point H.

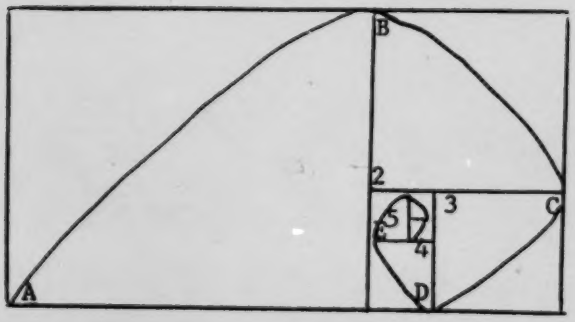


Measure to check if ABGH is a Golden Rectangle.



STOP

Drawing a spiral in a Golden Rectangle:



Divide the Golden Rectangle into a square and a rectangle; then divide the new rectangle into a square and a rectangle, and keep on in this manner until you have two squares.

Place compass point at 1, and pencil A - draw arc to B. Place compass point at 2, and pencil at B - draw arc to C. Continue on in this manner.

IX.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Angles and Their Measure

DEVELOPMENTAL AREA: Decision Making, World of Work

INSTRUCTIONAL GOAL: to instruct the student in the art of measuring an angle using a protractor and to identify angles as being either acute, right, or obtuse.

DEVELOPMENTAL GOAL: to identify angles as to their types and to indicate the importance of angles in technology such as the construction trades, aviation and others.

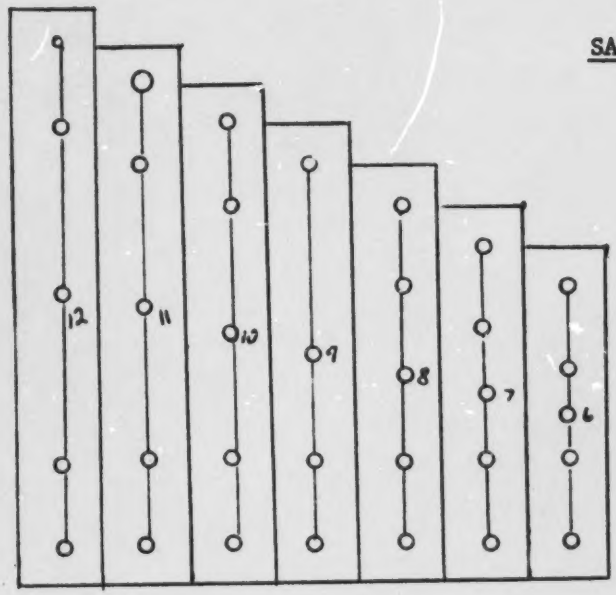
Performance Objective	Activities	Resource Materials
The student should be able to: 1. Measure an angle with a protractor with an accuracy of 1°. 2. Define obtuse, acute, & right angles. 3. Identify angles as being acute, obtuse or right. 4. Give some applications of angle measure in the world of work.	1. Use "Geostrips & Angle Fixers" to give students intuitive ideas about angle size. Point out that length of sides has no influence on angle measure. 2. Use worksheet or textbook problems concerning use of protractor and also identifying angles by types. 3. Show handout on aviation and how angle of take-off is affected by weather. Include description of the "angle of bank." Have students measure these angles. 4. Discuss different occupations where knowledge of angle measure is necessary & bring in clippings from magazines or paper to illustrate.	1. Protractors and worksheets. 2. Geostrips (different sizes). [attached worksheet] 3. Paper fasteners. 4. Construction paper. 5. Hole puncher. 6. Aviation handout. 7. Pilot or student pilot to discuss aviation and its geometrical relations.

* FROM: The Arithmetic Teacher
Vol. 22, Number 4, April, 1975

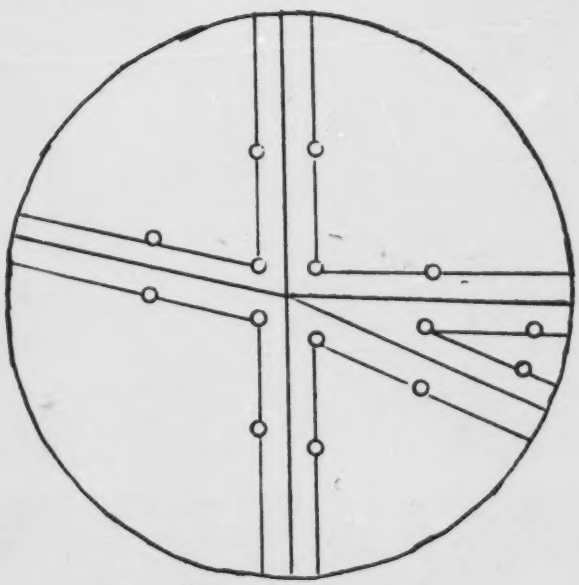
Using Geostrips and Angle Fixers

The geostrips and angle-fixers are made of construction paper. The holes are made, as indicated, with a hole punch (preferably one that makes very small holes). It is convenient for the strips to be 2 centimeters wide and to have different lengths. The numbers indicated on the strips represent the distance in centimeters between the end-holes of the strips. In making models with the geostrips, this distance is the length. You will need strips ranging in length from 6 to 24 centimeters. Each strip has 5 holes: two holes that are 2 centimeters apart at each of the strip and one hole at its midpoint.

To make angle-fixers, begin with a circle with a radius of 5 centimeters. Make "sectors" that vary in angle size. The patterns for angle-fixers should include 30, 45, 60, 75, 90, 105, 135, 150, and 180 degree angles, but initially they should not be labeled as such (you may wish students to label in degrees later). On each sector, draw a red line segment along each straight side 1/2 centimeter from the sides, as shown, and punch a hole where the segments intersect. Each of the holes along the "sides" of the angle-fixers should be 2 centimeters from this hole.



SAMPLE PATTERNS FOR GEOSTRIPS



SAMPLE PATTERN FOR ANGLE-FIXER

ANGLES

Before students are taught to measure the size of an angle with a protractor, they should have experience in making models of angles and in estimating the sizes of angles. Two strips joined by a brass fastener at their end holes can be thought of as a model of an angle.

1. Tell students to hold one strip still and rotate the other one about the brass fastener. Ask "What is changing?" (Answer: As strip is turned, the "amount of opening is changed.") Ask, what is the largest opening? and what is the smallest opening?

2. At this point, the "angle-fixer" can be introduced by using an angle-fixer you can keep the opening between two strips from changing ("fix" an angle). Have students use different angle-fixers and compare the resulting molds.

3. For students to show one opening is larger than another--they may place one model on top of another.

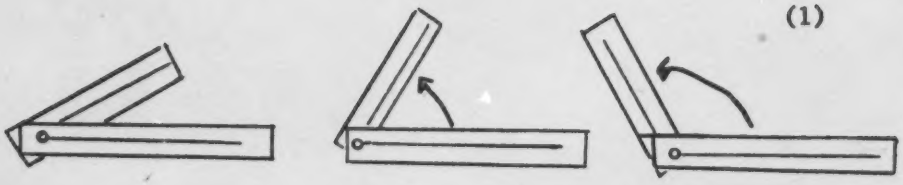
4. Students can also realize that the size of an opening <u>does not</u> depend on the length of the strips used. As they compare sizes of openings, ask students to arrange the models in order from smallest to largest opening.

5. Once students realize how angle-fixers influence the sizes of these models of angles, you can introduce activities such as the following to develop an understanding of specific kinds of angles.

6. When the right angle and the straight angle are understood, models of acute and obtuse angles can be made and identified.

7. When you introduce the degree as a unit of measure, students can discover ways to find the measures of all the angle-fixers. Starting with an angle-fixer that can form the model of a right or 90° angle, children can find the number of degrees in the other angle-fixers. By placing smaller angle-fixers on the top of the 90° angle-fixer, students can then figure out the number of degrees in the small angle-fixers.

In a similar way, students can find the measure in degrees of all the angle-fixers without using a protractor. These kinds of experiences can give them a better understanding of angular measurement and increase their ability to estimate the size of an angle.



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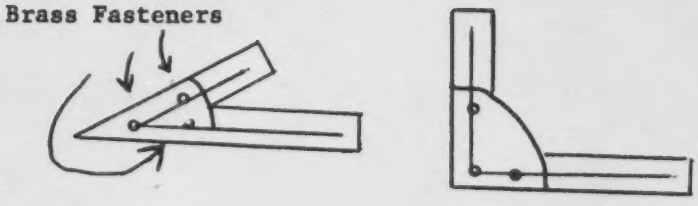

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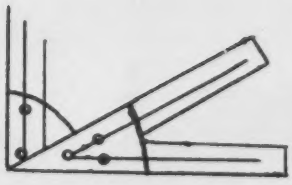

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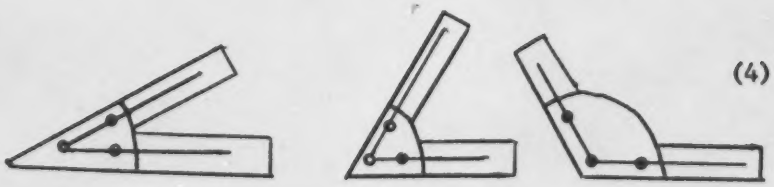
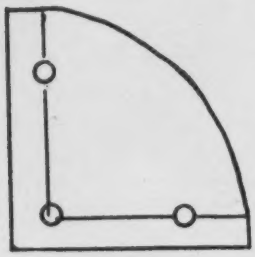


(4)

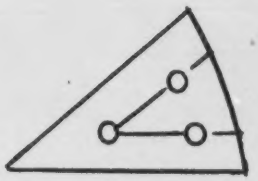
5. Find an angle-fixer that makes an angle like the corner of a book. This kind of angle is called a <u>right angle</u>.

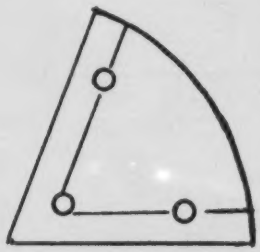
*Make a model of a right angle using two geostrips and an angle-fixer. Find <u>all</u> the angle-fixers that form right s.



6. Find all the angle-fixers that can form angles that are <u>smaller</u> than a right angle.

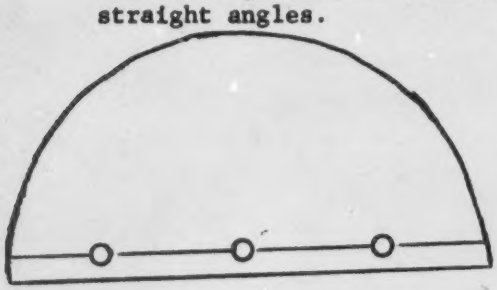
These angles are called <u>acute</u> angles. Make some models of acute angles using geostrips and angle-fixers.





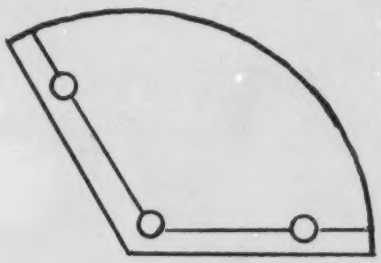
Find an angle that makes an angle like the edge of a book.

This kind of angle is called a <u>straight angle</u>. Make a model of a straight angle using two geostrips and an angle-fixer. Find all the angle-fixers that form straight angles.



Find all the angle-fixers that can form angles that are <u>smaller</u> than a straight angle, but <u>larger</u> than a right angle.

These are called <u>obtuse angles</u>. Make some models of obtuse angles using geostrips and angle-fixers.



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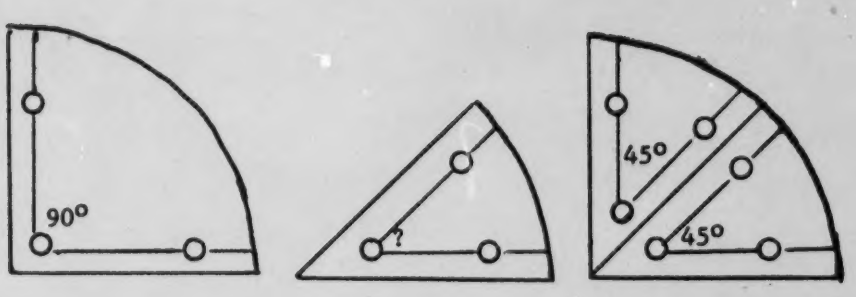


X.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Angles

DEVELOPMENTAL AREA: World of Work, Education and Training

INSTRUCTIONAL GOAL: to help the student learn the concept of angles and how they are used.

DEVELOPMENTAL GOAL: to help the student realize how geometric concepts, angle measure, are used in industry (Cincinnati Bell).

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Discuss angles & their use.	1. Text: Houghton-Mifflin, Possibly p.29.
1. Explain the concept of an angle.	2. Invite a speaker from Cincinnati Bell to explain geometry at his/her company. This can easily be done by conference phone.	2. Conference phone.
2. Give some examples of how angles are used by the telephone company or an industrial concern.		3. Speaker from Cincinnati Bell.

XI.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Deductive Reasoning

DEVELOPMENTAL AREA: Decision Making

INSTRUCTIONAL GOAL: to help the student learn the structure of deductive reasoning.

DEVELOPMENTAL GOAL: to place the student in the role of making decisions and to help the student see the value of planning in meeting their goals.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Reach a conclusion based upon a major premise and given data. 2. Extend the skills in deductive reasoning into life situations.	1. Draw a valid conclusion from a major premise and data. 2. Use specific examples: a. You want to enter the field of law enforcement as a 9th or 10th grader. What plans should you make to achieve this goal? b. As a tour guide, you are taking a group to the Smokey Mountains National Park. How do you plan to get there?	1. Text: Houghton-Mifflin, p.64-66.

PROBLEM--Major Premise:

People working in electronics have a good mathematics background.

Given Data: Ken is studying electronics for his career.

Conclusion:

XII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Deductive Proof

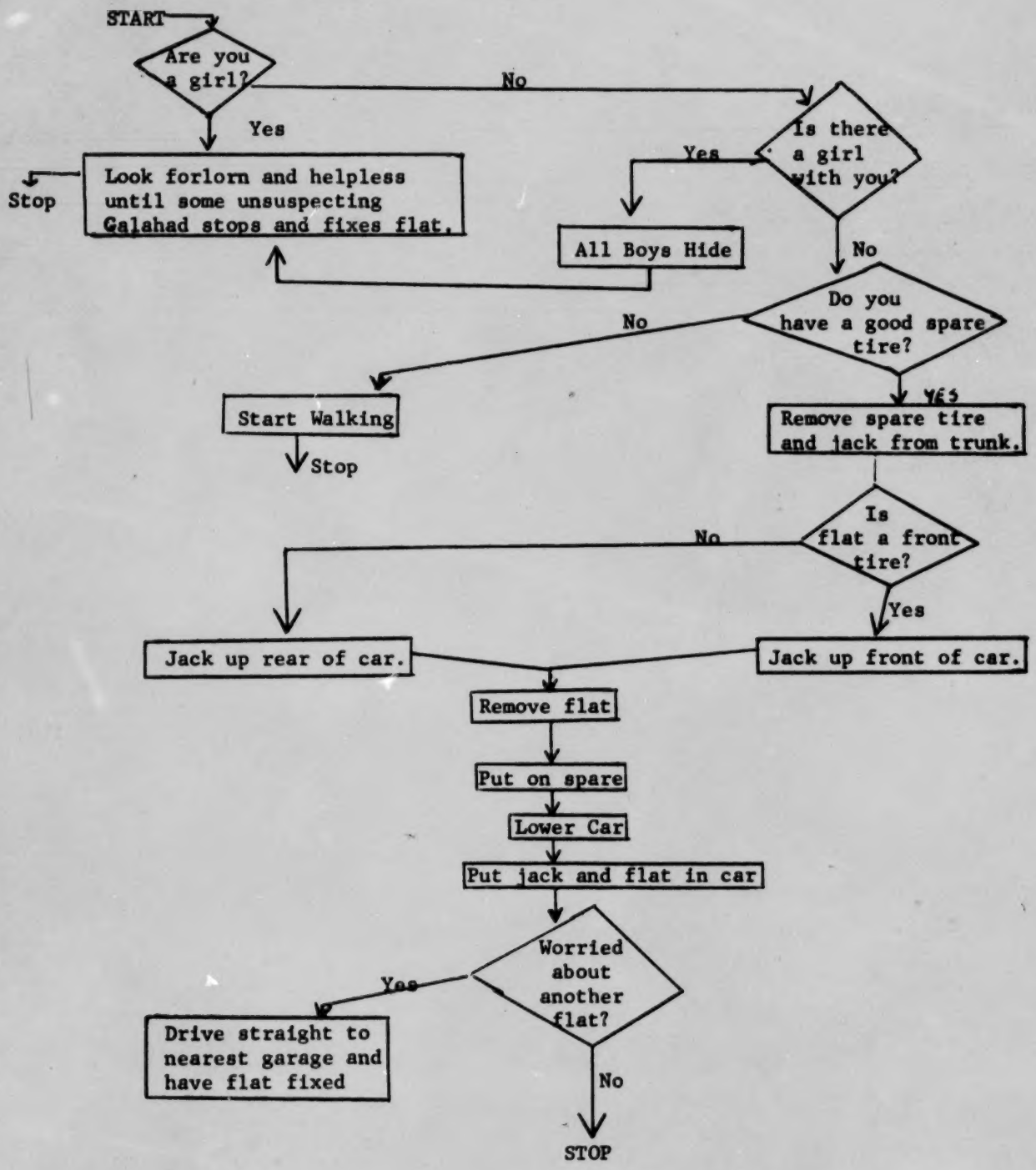
DEVELOPMENTAL AREA: Decision Making

INSTRUCTIONAL GOAL: to teach the student to write a deductive proof.

DEVELOPMENTAL GOAL: to help the student organize his/her thinking in order to make decisions which confront him/her daily.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. "Order" the steps in a proof. 2. Write a simple deductive proof. 3. Appreciate the importance of the sequence of steps in the solution of any problem.	1. Given a problem (such as p.112, #17-21), put the statements in the proper order with the matching reason, having been given all the statements and reasons; e.g., p.112, #17-21. 2. Write out on your own a problem such as on p.110. 3. Write a flow chart for an activity similar to the one for changing a flat tire. (attached example)	1. Text: Houghton-Mifflin, Modern School Mathematics. 2. Bell Telephone CARDIAC model. 3. Holt Geometry Book (pp.151, 394). 4. Film on computers from Bell Telephone and Board.

FLOW CHART FOR REPAIRING A FLAT TIRE



XIII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Deductive Proof

DEVELOPMENTAL AREA: Decision Making, Self

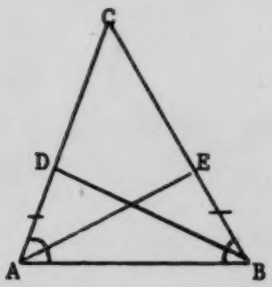
INSTRUCTIONAL GOAL: to teach the student to recognize unnecessary steps in a deductive proof.

DEVELOPMENTAL GOAL: to learn to work with group members in making decisions and thus learn more about one's self.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Recognize steps in a deductive proof which may be correct mathematically, but unnecessary for a complete proof. 2. Work as a group member on a problem involving decision making by the individual and by the group.	1. Pick out some unnecessary steps in a given completed proof. (attached worksheet) 2. Work in groups on the NASA survival group. (attached worksheet)	1. Text: Houghton-Mifflin 2. Designing For The Future, Xerox Corp. by Odvard Dyrli, Thomas Lanagan & Thomas Liao.

Pick out the unnecessary (although mathematically correct) steps in the following proof:

Deductive Proof:



Given: $\overline{AD} \cong \overline{BE}$; $\angle DAB \cong \angle EBA$

Prove: $\overline{BD} \cong \overline{AE}$

1. $\overline{AD} \cong \overline{BE}$, $\angle DAB \cong \angle EBA$	1. Given.
2. $\overline{AC} \cong \overline{BC}$	2. If two angles of a triangle are congruent, then the sides opposite these angles are congruent.
3. $\angle C \cong \angle C$	3. Reflexive.
4. $\overline{AB} \cong \overline{AB}$	4. Reflexive.
5. $\triangle ADB \cong \triangle BEA$	5. S.A.S.
6. $\overline{BD} \cong \overline{AE}$	6. Corresponding parts of congruent triangles are congruent.

Lunar Survival Problem: Form groups of from 4-7 persons.

The Situation

The lunar module Bluebird has just made a bad landing on the moon. Because of a descent propulsion system malfunction, its crew was forced to land against the wall of a crater. The spacecraft is tipped too severely to permit takeoff. Bluebird was supposed to land near Moonbase, which is 200 miles away. Aboard Bluebird are only the 15 survival items listed below.

Mission

Your mission is to reach Moonbase. You will have to do this on foot. Survival supplies at Moonbase will keep you and your crewmate alive until a rescue spacecraft can be sent.

Survival Procedure

1. By yourself, rank each of the 15 items listed here according to their importance to your mission. In the column marked Your Ranking, place a 1 by the most important item, 2 by the second most important and on through 15, the least important.

2. After you have finished your own ranking, compare and discuss your answers with the group members. All of you must arrive at a unanimously acceptable group decision. Record the rank order that the group works out in the Group ranking column.

Scoring Procedure

1. After filling in the individual and group ranking columns, the teacher will give you the NASA ranking. Fill in this column.

2. For each item find the difference in points between the NASA ranking and your ranking.

3. When you have completed your Error points column, add the error points together to find your own total error points. The lower the error total is, the better your score.

4. Determine the error points and total error for the Group also.

Are you a "Grouper" or a "Loner"?

Initiate discussion about whether a person's score is lower working alone or in a group. Did some individual do better than the group?

LUNAR SURVIVAL PROBLEM SHEET

	Your Ranking	Group Ranking	*NASA Ranking	Your Error Points	Group Error Points
Box of matches			15		
Food concentrate			4		
Fifty feet of nylon rope			6		
Parachute silk			8		
Solar-powered portable heating unit			13		
Two .45-caliber pistols			11		
One case of dehydrated milk			12		
Two 100-pound tanks of oxygen			1		
Stellar map (of moon's constellation)			3		
Self-inflating life raft			9		
Magnetic compass			14		
Five gallons of water			2		
Signal flares			10		
First-aid kit containing injection needles			7		
Solar-powered FM receiver-transmitter			5		
			Total Error Points		

*Do not write in NASA ranking on students worksheet. Give them this information separately when needed.

XIV.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Elementary Geometric Proofs

DEVELOPMENTAL AREA: Decision Making, World of Work

INSTRUCTIONAL GOAL: to develop the basic skills involved in setting up an elementary geometric proof involving congruent angles.

DEVELOPMENTAL GOAL: to give the student a good foundation in organizing their though processes in a clear sequential manner. The student should also be aware of possible applications in the field of computer programming.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Do the activity on accompanying sheet.	1. A number of computer programs.
1. Organize a simple geometric proof dealing with angles.	2. Have students complete proofs by adding reasons when steps are given.	2. Worksheet with proofs without reasons.
2. Supply reasons when given the statements of a geometric proof.	3. Have students do 5 proofs entirely from scratch.	
3. Give a number of similarities between writing a geometric proof and a computer program.	4. Discuss the actual thought processes and decision making processes which go into the step by step construction of a geometric proof.	
4. List some of the characteristics of the thought processes which go into a geometric proof.	5. Demonstrate for students the similarity between a geometric proof and a computer program. Have visible examples for them.	
	6. Introduce students to the concept of flow charting and see if they can make a flow chart for a simple proof.	

XV.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Classification of Triangles

DEVELOPMENTAL AREA: Self, Employability and Work Adjustment Skills

INSTRUCTIONAL GOAL: to classify triangles first by their sides and then by their angles.

DEVELOPMENTAL GOAL: to realize that people classify others.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Classify any triangle by its sides and its angles. 2. Know the conditions for each classification of triangles, both by sides and by angles. 3. Give a list of the most important criteria they use as they classify people. 4. Realize how they are classified by employers and why.	1. Classify all angles on a worksheet. 2. Do textbook problems (Holt, p.103, #1-16). 3. Have students work in groups to set up a criteria for classifying people by their work habits. 4. Have an employer come in and give students an idea of how he classifies employees. Students can then do a self-evaluation based on results of activity #4. 5. (See next page)	1. Triangle worksheet. 2. Holt Geometry Book.

Activities

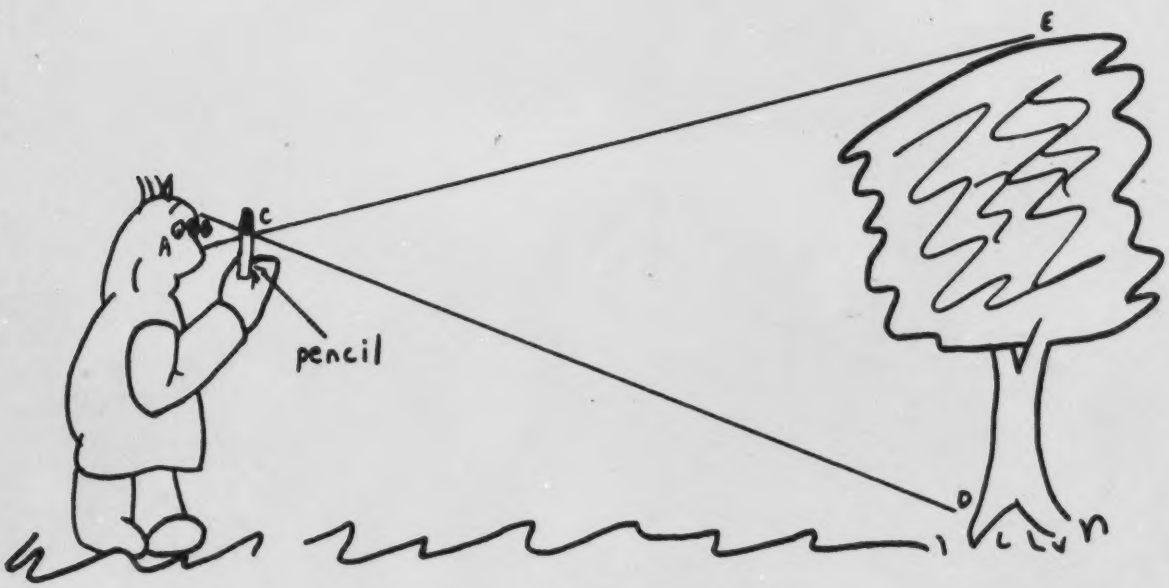
5. Have students determine the distance to an object by "sighting".

   METHOD: Stretch your right arm full length and shut your left eye. Hold a pencil (C) in the line of sight with your right eye (A) to a distant object such as a tree (E). Keep the pencil in the same position (C) close your right eye and sight with your left eye (B). Note the object (D) sighted in line with a pencil and the left eye. Estimate the distance between the objects sighted (DE). Compute the approximate distance to the objects (CD) with this proportion:

$$\frac{X}{BC} = \frac{DE}{AB}$$

   A simple way to make this approximation is to hold the pencil at a distance from your eyes which is ten times the distance between your eyes. Then the object will be ten times as far from you as the distance between the sighted objects.

   Example: AB = 4 in.; BC = 36 in.; DE = 6 ft.



XVI.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Similar Triangles

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to understand the properties of similar triangles and to determine whether two triangles are simila.

DEVELOPMENTAL GOAL: to illustrate the use of similarity in everyday situations.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Work problems in chapters 8-9.	1. Text, Houghton-Mifflin.
1. State the properties of similar triangles.	2. Construct a pantograph p.307.	
2. Find the missing side given the ratio between 2 similar triangles.	3. Work problems 1-2 p.306.	
3. Give examples of similarity used in everyday situations.	4. Work out a project of photographs compared with the negatives. Enlargements of a photograph.	

XVII.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Similar Triangles

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to understand the concept of similar triangles and to use ratio-proportion techniques in solving problems which involve similar triangles.

DEVELOPMENTAL GOAL: to understand the concept of similar triangles as used by surveyors.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Solve for the missing side using ratio-proportion when proper information is provided. 2. Define similar triangles. 3. Solve some elementary surveying problems concerning similar triangles.	1. Work problems from textbook, (Holt, p.255-256). 2. Ask a surveyor to come in and give examples of types of problems where he/she uses the principle of similar triangles. 3. Ask the student to devise three surveying problems of the type discussed. Then solve them. 4. Take entire class outside and find height of flagpole (or some such thing) using the shadows and ratio-proportion techniques.	1. Rulers or yardsticks. 2. Holt Geometry Book.

XVIII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Proportionality

DEVELOPMENTAL AREA: World of Work, Education and Training

INSTRUCTIONAL GOAL: to recognize when a proportion may be used to solve a problem and how to set it up and solve it.

DEVELOPMENTAL GOAL: to investigate the use of proportion by the brickmason and the printer.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Illustrate the use of the properties of proportions. 2. Show knowledge of applications of proportions by working examples from the brickmason and printer's trades.	1. Work problems on p.283, Text. 2. Work problems related to the printer and the brickmason. (problems attached)	1. Text: Houghton-Mifflin. 2. Supplemental Problems: Geometry in Occupation, Walch Publ.

Brickmason:

You have been called out to estimate the cost of rebuilding the chimney of a huge incinerator. You have no ladder with you, and the customer does not know how high his chimney is. You must know this before you can tell how many bricks will be needed to rebuild the chimney. The chimney casts a shadow of 64 feet. You are 6 ft. tall and cast a shadow of 4 feet.

Solution: Because the angles formed by the sun's rays are equal, similar triangles would be formed:

$$\frac{6}{4} = \frac{X}{64}$$

$$4X = 384$$
$$X = 96 \text{ ft.}$$

Printer:

Suppose that you are the chief printer for the Red Monkey Printing Company. You have been asked to design a card six inches long, and wide enough so that when folded in half, it will have the same shape as when it is unfolded. What should the width of the card be, and how would you find it?

Solution: $\frac{6}{X} = \frac{X}{3}$

$$X^2 = 18$$

$$X = \sqrt{18} \text{ or } 3\sqrt{2} \approx 4.24 \text{ inches}$$

XIX.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Ratio and Proportion

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to provide student with the knowledge of what a ratio is and how a ratio-proportion problem is solved.

DEVELOPMENTAL GOAL: to give student an idea of how ratios are useful in the world of work using examples such as gears and scale drawings.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Find a simple ratio of two numbers. 2. Recognize if a proportion is true or false. 3. Solve ratio-proportion problems. 4. Apply ratio proportion problems to scale drawings to find actual dimensions from a scale drawing.	1. Work problems from book dealing with ratio-proportion. 2. Show the ratio between two gears and demonstrate: $\frac{\text{teeth A}}{\text{teeth B}} = \frac{\text{rate B}}{\text{rate A}}$ 3. Have students take a scale drawing and translate all measurements into actual size when given the scale ratio. Make problem of a type that ratio-proportion technique is needed for solution.	1. Two small gears of different sizes. 2. Copies of four different scale drawings. 3. Have an automobile mechanic explain to students what a transmission ratio is and how the automobile industry arrives at the proper ratio. 4. Get a draftsman to speak to class about basics of scale drawings and the tools that are used today.

XX.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Ratio and Proportion

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to help the student understand ratio and the properties of proportion.

DEVELOPMENTAL GOAL: to help the student apply this information to a career in architecture.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Do some exercises from text, p.280-284.	1. Text: Houghton-Mifflin.
1. Work with ratios and proportions.	2. Do Specific Problem* (see attached page)	2. Algebra 2 and Trig by Dolciani, et.al. Publ by Houghton-Mifflin.
2. Name some examples where this might be used in careers, particularly architecture.		

*SPECIFIC PROBLEM

In designing a structure, an architect must make sure that, in addition to meeting his client's requirements, it will be safe and attractive.

Example: An architect is designing a house which will be 10 meters long and 8 meters wide. A scale drawing of the floor plan is 30 cm by 24 cm. In the drawing, find the dimensions representing a 4.2 m x 5.5 m living room.

Solution: 1m = 100 cm so 10 m = 1000 cm. Using the proportion:

$$\frac{\text{actual size}}{\text{drawing size}} = \frac{1000}{30}$$

We have:

$$\frac{420}{w} = \frac{1000}{30} \text{ and } \frac{550}{1} = \frac{1000}{30}$$

$w = 12.6$ cm $\qquad\qquad$ $1 = 16.5$ cm

XXI.

SUBJECT: Geometry (A) - Grades 9-10

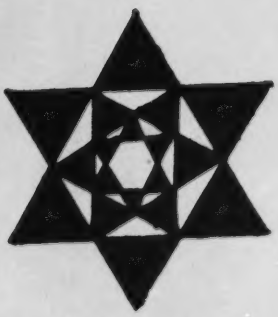
INSTRUCTIONAL TOPIC: Polygons

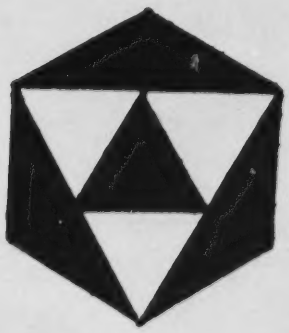
DEVELOPMENTAL AREA: Individual and Environment

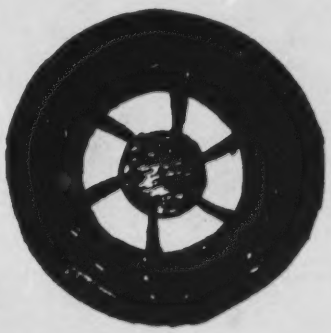
INSTRUCTIONAL GOAL: to know the fundamental concepts about the polygon.

DEVELOPMENTAL GOAL: to appreciate designs made using polygonal regions and natural polygonal designs occurring in nature.

Performance Objective	Activities	Procedures/ Resource materials
The student should be able to:		
1. Answer questions about polygons.	1. Answer questions such as on p. 180 of text.	1. Text: Houghton-Mifflin.
2. Make some designs in a polygon.	2. Make some original designs similar to the examples below.	2. Applications in Mathematics, Johnson et al. Scott, Foresman and Co.
3. Appreciate designs in nature.	3. Give some examples of polygonal designs in nature such as pentagons in flowers.	3. Donald Duck In Mathemagic Land. Movie from Board (Polygons in nature)







XXII.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Regular Polygons

DEVELOPMENTAL AREA: Decision Making, World of Work

INSTRUCTIONAL GOAL: to name and define regular polygons. To construct several types of regular polygons given a straight line or angle.

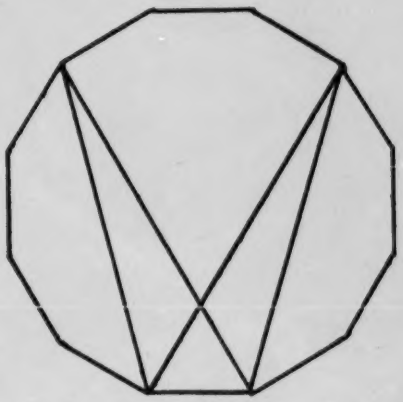
DEVELOPMENTAL GOAL: to recognize regular polygons and realize how various sided polygons (their properties) play an important role in the arrangement in shape of various natural phenomena and their application to the world of work.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Write definition of a regular polygon & name the various regular polygons given the number of sides. 2. Construct several types of regular polygons given a line segment. 3. Recognize the importance of the relation of the central angle to the number of sides of a regular polygon.	1. Have the student bring a mirror (small square) to be used with one fellow student in completing the experiment "A Kaleidoscope for Producing Regular Polygons". (Covers central angle) 2. Give each student a "Dissection Puzzle" which allows him/her to go from one regular polygon form to another. 3. Discuss with the class how regular polygons are found: a. In nature (bees) b. In chemistry (molecules) c. In furniture making (holder for wood lathe tool)	1. Compass, straightedge 2. Mirrors. 3. Scissors. 4. Copies of dissection puzzle. 5. Copies of directions for making "A Holder for Wood Lathe Tools". 6. Chemist and beekeeper to speak to class. 7. Film, Mathematics of the Honeycomb available from Board. 8. Jacobs: Mathematics A Human Endeavor, W. H. Freeman Co., pp. 192-193. 9. Lyng Meconi Zwick, Career Mathematics, Houghton-Mifflin, pp. 236-237.

Here is an interesting puzzle. It is called a dissection puzzle and the problem is to cut a regular dodecagon up into pieces that can be arranged to form a square. Some dissection puzzles were discovered by the Greeks, and in the 10th century a Persian mathematician wrote an entire book about them. Another book has been written recently by the world's current expert on dissection puzzles, a man who lives in Australia.*

Place a sheet of paper underneath the large dodecagon you constructed in Set I and poke a hole with the metal point of your compass at each of the 12 corners. Now join the 12 holes on your new sheet of paper to form another dodecagon and then draw in 4 more line segments like those shown in the figure below to divide it into 6 parts. Notice that the resulting figure has line symmetry and that one of the 6 parts seems to be an equilateral triangle.

Cut the 6 pieces apart with scissors and try to rearrange them to form a square. If you can, make a sketch to show what the arrangement of the pieces looks like.



INTERESTING READING

The Borders of Mathematics, by Willy Ley, Pyramid Books, 1967: Chapter 2, "The Seven-Spoked Wheel," and Chapter 3, "Enter Carl Friedrich Gauss."

* Geometric Dissections, by Harry Lindgren, Van Nostrand 1964.

XXIII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Pythagorean Theorum

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to help the student understand and use the Pythagorean Theorum.

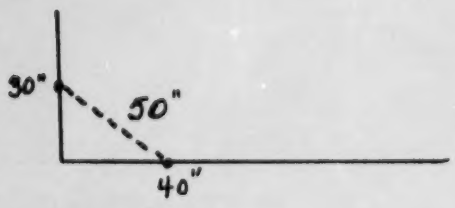
DEVELOPMENTAL GOAL: to help the student understand how this knowledge might be used in the trade of a carpenter.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Do some exercises in text, p.322-323.	1. Text: Houghton-Mifflin.
1. Use the Pythagorean Theorum.	2. Do specific problem (below).	2. Geometry in Occupations, by William Tessenden, Publ. Walch.
2. Show how the Pythagorean Theorum is used by a carpenter.		3. Resource persons in vocational building from the construction trades.

Specific Problem:

You have been asked to lay foundation lines for a new house. You should know how long and how wide it is to be. What you must make sure of is that the corners of the house are square. This is one way it can be done.

Construct the four corners of the foundation. Taking each corner separately, measure from the corner 30" down one side and 40" down the other. A straight line connecting these two points should measure 50 inches if the corner is square.



$$a^2 + b^2 = c^2$$

$$30^2 + 40^2 = 50^2$$

$$900 + 1600 = 2500$$

XXIV.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Pythagorean Theorem

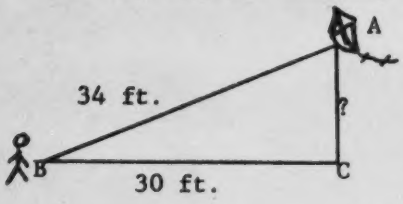
DEVELOPMENTAL AREA: Education and Training

INSTRUCTIONAL GOAL: to help the student learn to use the Pythagorean Theorem.

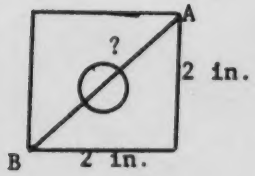
DEVELOPMENTAL GOAL: to help the student realize some of the many uses of the Pythagorean Theorem in the home, on the job, etc.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Compute for A, B, or C in $A^2 + B^2 = C^2$. 2. Name three applications of Pythagorean Theorem in the home, recreation, etc.	1. Do some exercises from the text. 2. Show through specific problems some of the many uses of the Pythagorean Theorem at home, on the job, etc. 3. Work related problems on attached worksheet.	1. Text: Houghton-Mifflin. 2. Applications in Mathematics by Johnson, et.al. Publ. Scott Foresman. 3. Film, "Possibly So, Pythagoras."

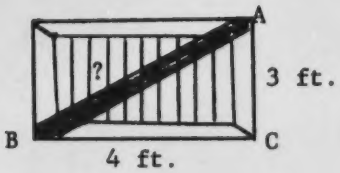
FIND THE MISSING LENGTHS:



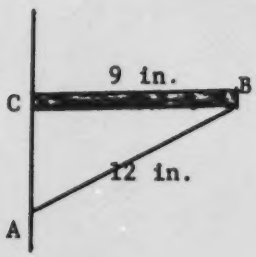
1. How high is the kite?



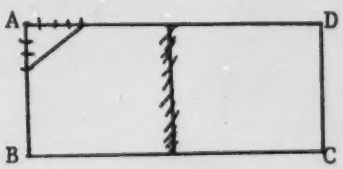
2. Find the length of the diagonal of the nut.



3. How long is the Brace from A to B?



4. How many inches below point C should the end of the brace be placed so that angle C is a right angle?



5. You are laying out a rectangular tennis court. How can you be sure that the angles at A, B, C, D are right angles?

XXV.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Pythagorean Theorem

DEVELOPMENTAL AREA: World of Work, Decision Making

INSTRUCTIONAL GOAL: to use the Pythagorean Theorem to find lengths of missing sides of a right triangle, given two sides.

DEVELOPMENTAL GOAL: to visualize and utilize the Pythagorean Theorem and to realize its importance to various fields in the world of work.

Performance Objective

The student should be able to:

1. Write Pythagorean Theorem from memory.

2. Solve for missing sides of a right triangle given two sides.

3. List at least three applications of the theorem in the world of work.

Activities

1. Write out the theorem and solve for sides a, and b (or two legs).

Ex: $C^2 = A^2 + B^2$

$A^2 = C^2 - B^2$

$B^2 = C^2 - A^2$

$C = \sqrt{A^2 + B^2}$

$A = \sqrt{C^2 - B^2}$

$B = \sqrt{C^2 - A^2}$

2. Use the theorem to solve for missing sides of right triangle.

3. Prove that the theorem works by completing the three "Pythagorean Puzzles".

4. Give the student examples of the use of the Pythagorean Theorem in the construction trade.

a. laying foundation for a home.

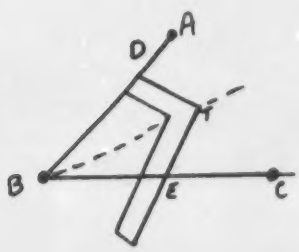
Resource Materials

1. Textbook problems.

2. The three "Pythagorean Puzzle" duplicates.

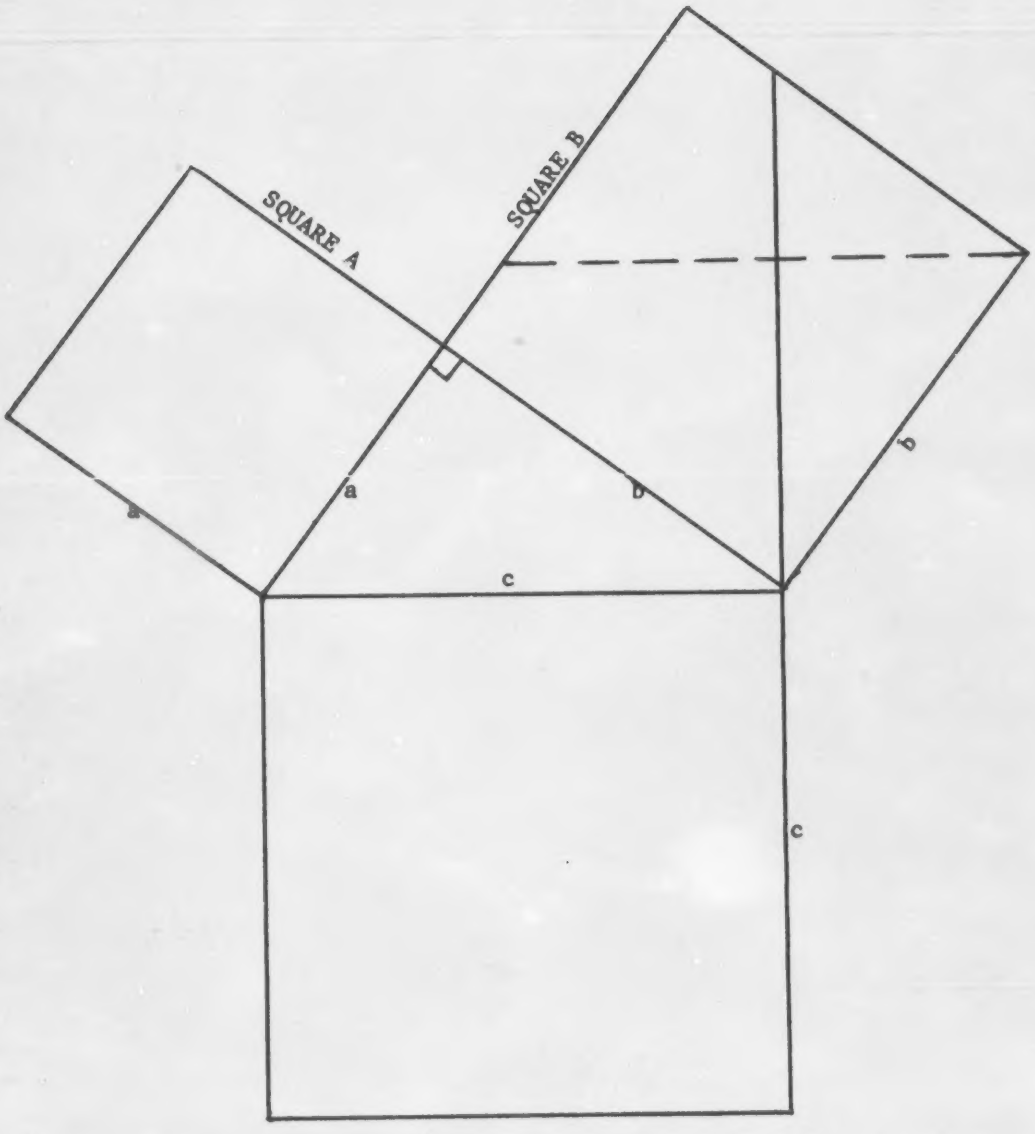
3. "Carpenter's Square".

Performance Objective	Activities	Resource Materials
	4. b. Bring in Carpenter's Square and test to demonstrate accuracy of instrument.	
	5. Have the students discuss what other fields would use this theorem.	
	6. Bisect an angle using a carpenter's square. Place carpenter's square so the DT = TE and BD = BE.	



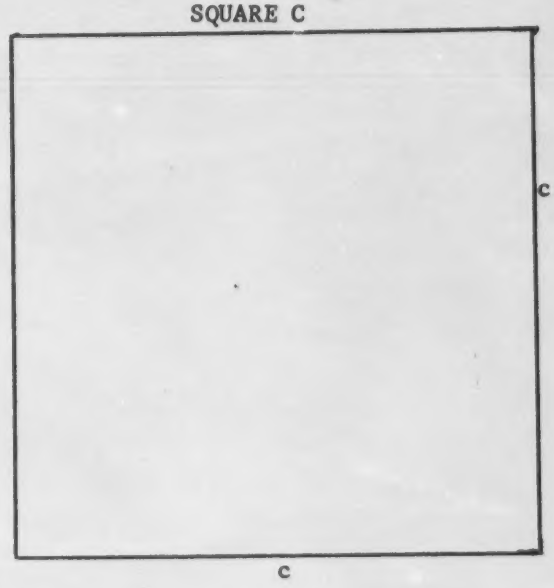
PYTHAGOREAN PUZZLE I

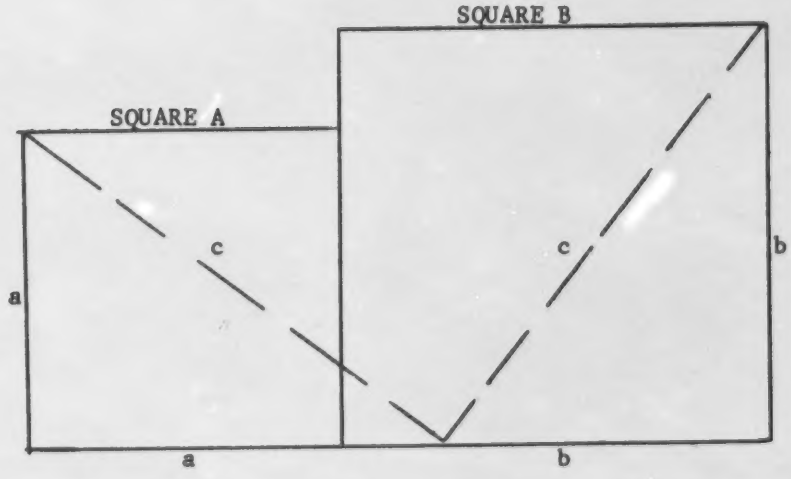
1. Cut out square A and the four pieces from square B.
2. Show how the pieces can be arranged to cover square C.
3. Does $a^2 + b^2$ appear to equal c^2? Why?



PYTHAGOREAN PUZZLE II

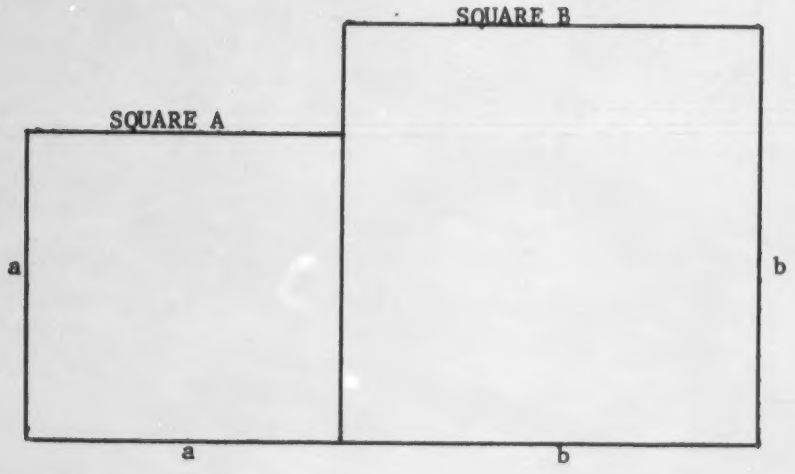
1. Cut out the five pieces from squares A and B.
2. Show how the pieces can be arranged to cover C.
3. Does $a^2 + b^2$ appear to equal c^2? Why?

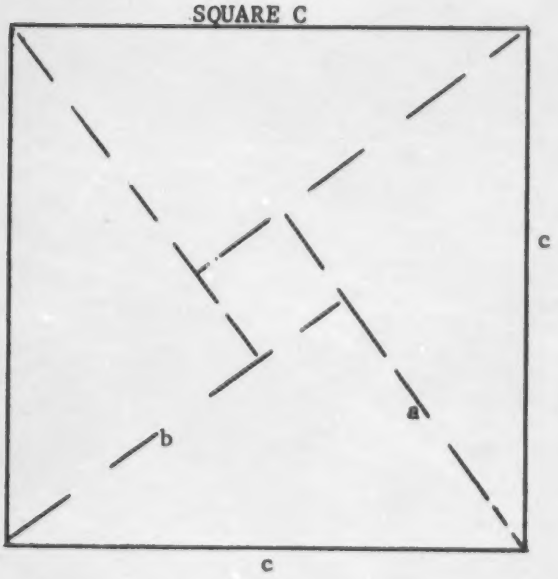




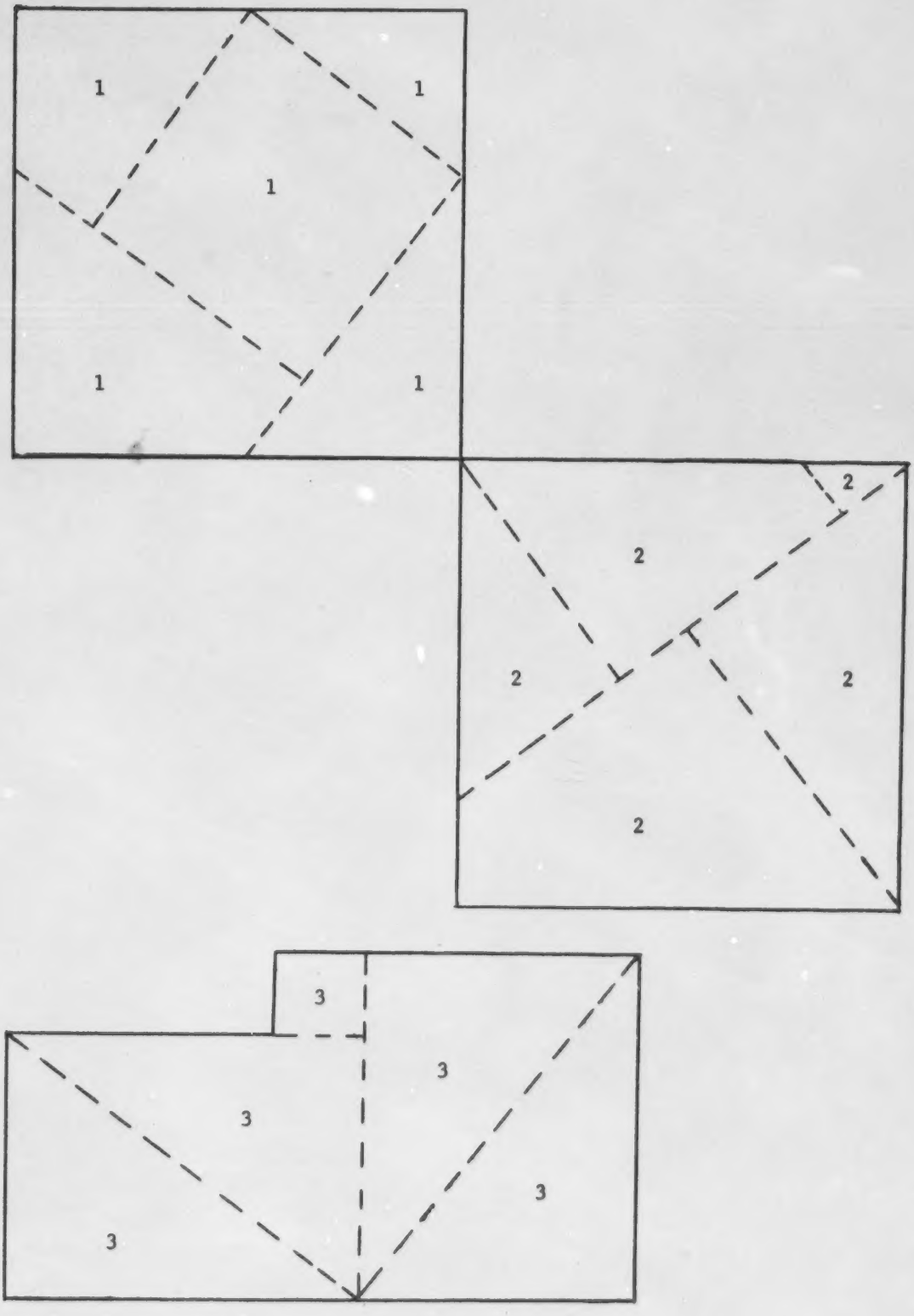
PYTHAGOREAN PUZZLE III

1. Cut out five pieces from Square C.
2. Show how the pieces can be arranged to cover Squares A and B.
3. Does $a^2 + b^2$ appear to equal c^2? Why?





SOLUTIONS



XXVI.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Coordinates and Distance

DEVELOPMENTAL AREA: World of Work, Individual and Environment

INSTRUCTIONAL GOAL: to demonstrate the use of the metric and English systems.

DEVELOPMENTAL GOAL: to realize the necessity for precise measurement in various jobs.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Measure line segments with an accuracy of 1/16 in. or 1/10 cm. 2. Perform specific tasks requiring numerous precise measurements while working in a group of 2 or more.	1. Discuss the work of the architect, carpenter, tool and die maker and tailor and how precise measurements are necessary. 2. Have students measure desk tops, bulletin boards, chair legs, sewing material and other things of this nature, including geometric figures. 3. Have students measure various line segments from a worksheet. 4. Have students work in groups measuring the dimensions of simple scale blueprint and decide how much wood baseboard would be needed for each drawing. There should be several different blueprints. Have some English units & others in metric units.	1. Six blueprints and copies. 2. Scrap material. 3. Geometric figures. 4. Speaker from the Bureau of Weights and Measures to discuss the impact of the International Standard on the economics of manufacturing and business.

XXVII.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Coordinate Geometry

DEVELOPMENTAL AREA: Employability and Work Adjustment Skills

INSTRUCTIONAL GOAL: to interpret ordered pairs of coordinates and graph them on a Cartesian coordinate graph.

DEVELOPMENTAL GOAL: to enable students to view jobs not only from the employee's standpoint, but also from the employer's standpoint.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Graph points given coordinates and vice versa. 2. Look at a new (but related) coordinate system and explain how the visual picture will change. 3. Understand the idea of looking at things from a different viewpoint and apply this to the world of work. (Viewpoint of employer vs. viewpoint of employee).	1. Work on textbook exercises to develop basic skills. 2. Have students graph a particular figure by graphing its vertices. Then change one or both of the coordinate systems. (For example: make X-coordinate system twice the size of Y-coordinate system.) See how this changes the figure. 3. Have students discuss the difficulties in seeing things from more than one viewpoint. 4. Have students role-play a situation where there is a conflict on the job and have students take opposing sides. Discuss outcomes of this activity.	1. Textbook or worksheet for problems. 2. Film from series Bread and Butterflies: "I Agree, You're Wrong", Princeton School District. 3. Film, "What Do We Look Like To Others?" Cincinnati Public Schools Catalog No. 1017.

XXVIII.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Central Angles, Angles, Arcs of Circle

DEVELOPMENTAL AREA: Decision Making, Work Adjustment Skills

INSTRUCTIONAL GOAL: to recognize significant ideas about angles and arcs of circles.

DEVELOPMENTAL GOAL: to develop positive attitudes toward working with others whose opinions may be varied from his own through an activity involving two partners and a "geoboard".

Performance Objective

The student should be able to:

1. Demonstrate his knowledge that:

   a. There are 360° of arc in a circle.
   b. The sum of the angle measures of a triangle is 180°.
   c. The angles opposite equal sides of a triangle are congruent.

2. Share opinions and work together to combine data.

Activities

1. Work in groups of 2 on the activity "Thought Starters" for the circular geoboard. (See attached sheet)

2. Have groups compare findings at end of activity.

Resource Materials

1. Geoboards piece of plywood or similar material about 8 in. square with a nail at the center and a circle outlined on it with twenty-four nails driven at equal intervals on the boundary.

2. Rubber bands (used to make geometric shapes by stretching from nail to nail).

3. Protractor.

XXIX.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Central Angles in a Circle

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to help students learn concept of central angles, their arcs, their chords.

DEVELOPMENTAL GOAL: to investigate applications in design.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Do some exercises from te t, p.368-369.	1. Text: Houghton-Mifflin.
1. Solve problems dealing with central angles.	2. Work specific problems (see below).	2. Vocational and Tech Math in Action, by Samuel Levine.
2. Name places where this design might be used in industry.	a. Auto wheels b. Cylinder heads	3. Geometry in Occupations, by William Fessenden; Publ. J. Walch.

Problem: Wheels are bolted to an auto by lug bolts. Five bolts are equally spaced.

Problem: Cylinder heads are bolted to keep internal pressure from escaping. Eight bolts are equally spaced. Since the sum of the central angles is 360°, each central angle will be 360/8 = 45°.

XXX.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Circumference of a Circle

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to learn to compute the circumference of a circle.

DEVELOPMENTAL GOAL: to realize how this can be used in construction of pulleys.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Work exercises from text, p.569.	1. Text: Houghton-Mifflin.
1. Solve problems on circumference of circle.	2. Work specific problem. (see below)	2. Vocational and Technical Math in Action, by Samuel Levine.
2. Name places where pulleys might be used.	3. Use pulleys of different size -- such as a bicycle.	

Problem: Find the length of belting used by two pulleys.

$C = \pi d$

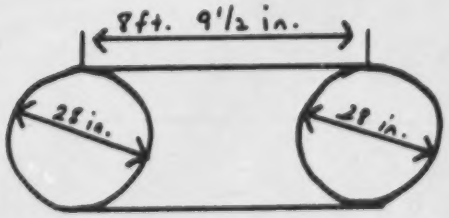
$C = (22/7)\ (28)$

$C = 88$ in. or 7 ft. 4 in.

Total belt length = T

T = 7 ft. 4 in. + 2 (8ft. 9-1/2 in.)

T = 24 ft. 11 in.



XXXI.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Area of Circle

DEVELOPMENTAL AREA: World of Work, Education and Training

INSTRUCTIONAL GOAL: to compute areas of circles.

DEVELOPMENTAL GOAL: to show the use of math in civil engineering.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Do a few problems from text, p.571.	1. Text: Houghton-Mifflin.
1. Solve for the area of a circle.	2. Work the problem below.	2. Geometry in Occupations by William Fessenden, Publ. J. Walch.
2. Give examples of application in field of civil engineering.	3. Find the math requirements for a civil engineer by using college catalogs.	

Problem:

A civil engineer must design a tunnel to be built under Moon River. It is to be a semi-circle, 21 ft. high and 1/4 mile long. What is the total number of cubic yards of earth to be removed?

Solution:

$$A = \frac{\pi r^2}{2} \qquad A = \frac{3.1416 \times 21^2}{2} = 692.72 \text{ sq. ft.}$$

1/4 mi. = 1320 ft.

692.72 x 1320 = 914,390.4 cu. ft.

= 33,866.3 cu. yds.

XXXII.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Area of a Circle

DEVELOPMENTAL AREA: Economics

INSTRUCTIONAL GOAL: to instruct the student on finding the area of a circle by using the formula:

$$A = \pi r^2$$

DEVELOPMENTAL GOAL: to appreciate the value in unit pricing.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Solve simple area problems involving circles. 2. Know relationship D = 2r. 3. Find the cost per square inch of a circular pizza given the radius or diameter and the cost. 4. Understand the advantages of finding cost per square unit to a consumer, and then decide which size would best suit individual needs.	1. Solve tractitional area problems for circles from textbook. 2. Have students find cost per square inch of all pizza sizes form a local pizzeria. 3. Compare results from Activity #2 and draw any conclusions. 4. Have students list other items which they as consumers might have to check for price comparisons by size. Actually check prices on a couple of items in class.	1. Menu from local pizzeria. 2. Prices from grocery store.

XXXIII.

SUBJECT: Geometry (A) - Grades 9-10

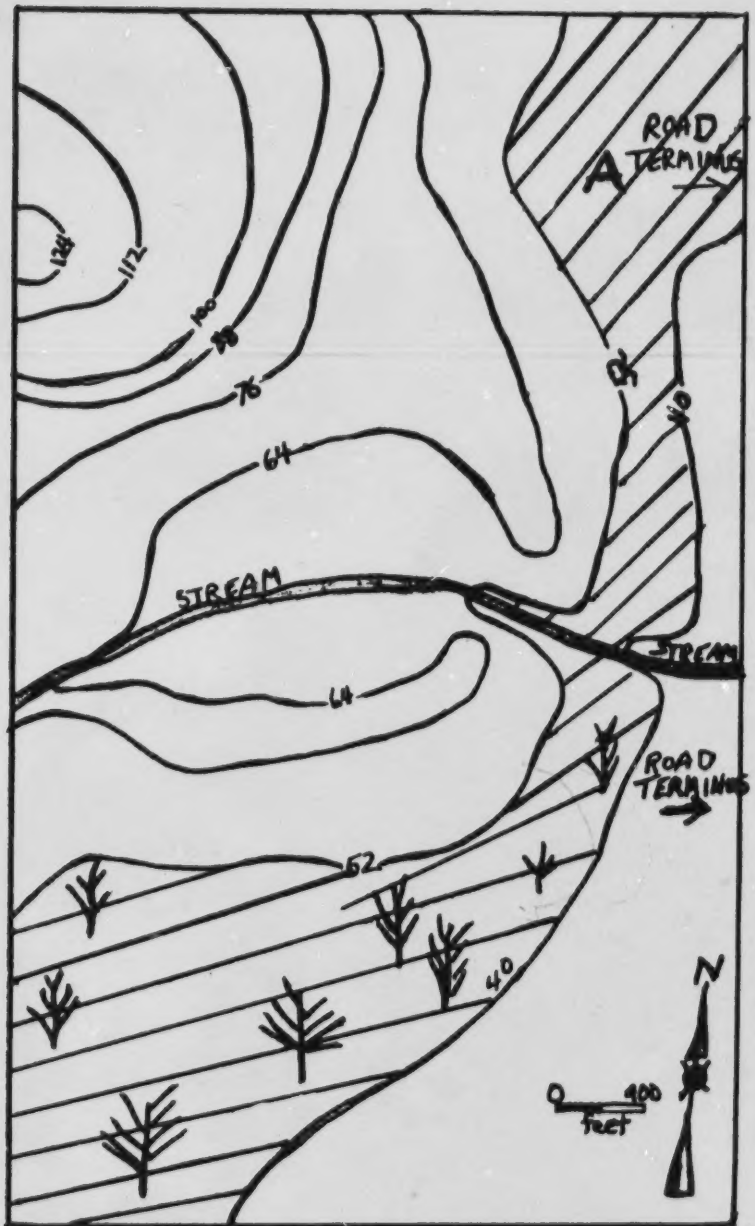
INSTRUCTIONAL TOPIC: Area of Rectangle and Square

DEVELOPMENTAL AREA: Individual & Environment, Decision Making

INSTRUCTIONAL GOAL: to fund the area of a rectangle and square.

DEVELOPMENTAL GOAL: to make the best decisions as a member of society and to appreciate the importance of design and environment.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Find the area of a rectangle or square given its dimensions. 2. Work on design problem; appreciate the interrelationship of man and the environment.	1. Work problem like those on p.551, text. 2. Design your own dream community. (attached problem)	1. Text: Houghton-Mifflin. 2. Supplemental problem. Designing for the Future, Xerox.



COMMUNITY DEVELOPMENT MAP

1. You are to place 50 homes, apartments, or combinations of both on the property shown on the map.

2. The numbers on the contour lines show the elevation in feet represented by the contour lines.

3. The land is all wooded with the exception of the area marked A. Area A was part of a farm until six years ago. It is covered with grasses, very young trees, and some shrubs.

4. Shere is a major north-south highway approximately one mile to the east of this parcel of land, and roads leading to that highway terminate at the edge of the property as marked.

5. Running across the parcel is a spring-fed stream that has a moderate flow even during dry weather.

PROCEDURE

How large is your parcel of land? _____acres (43,560 sq.ft. = 1 acre)

How much land is that per living unit? _____acres

1. Living Units:

Use 50 pieces of paper book matches 1/2" long to represent living units. Cut off the head of each match end and then cut the remaining portion in half to make two units. Each living unit is equivalent to an area 25 feet by 100 feet. You can stack and arrange the match sticks to represent apartment dwellings, trailers, and private homes.

2. Build a Model:

Make a three-dimensional map of your development.

4. Plan your community. Be sure to account for the following:

a. Power and water supplies.
b. Waste removal and processing.
c. Road locations.
d. Minimal damage to the natural terrain.
e. Recreational facilities.
f. A part of total area held as public land.
g. Establishment of small shopping area.

XXXIV.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Application of Area

DEVELOPMENTAL AREA: Economics, Decision Making

INSTRUCTIONAL GOAL: to enable the student to compute the area of rectangles.

DEVELOPMENTAL GOAL: to make decisions concerning the purchase of carpeting using given data, math skills, and the advertising media.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Find the area of a given rectangle or square given the specific dimensions. 2. Change from dimensions of square feet to square yards and vice versa. 3. Find the cost of an entire piece of carpeting given the dimensions and cost per square yard. 4. Determine whether the product is really a good buy or not, using advertisements.	1. Work area problems. 2. Take advertisements and compare remnant prices to price per square yard. 3. Discuss which carpet outlet offers the best buy. 4. Permit the student to role play various positions or vocations within the carpet industry. 5. Divide class into groups with each group working on different ads where each group sets up own criteria for buying carpet. 6. Have the student determine the cost of carpeting several rooms from a blueprint.	1. Sunday Enquirer. 2. Blueprints. 3. Speaker from carpet outlet.

XXXV.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Surface Area

DEVELOPMENTAL AREA: Decision Making, Economics

INSTRUCTIONAL GOAL: to compute the total surface of a right rectangular prism.

DEVELOPMENTAL GOAL: to choose the best solution from several possibilities.

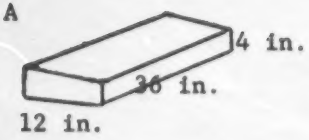
Performance Objective	Activities	Resource Materials
The student should be able to: 1. Compute the total surface area of a right rectangular prism. 2. Choose the best possible solution.	1. Do some exercises from text, p.592, 1-4. 2. Do specific problem below. Can be individual or in groups. (Students can give two other examples - F, G.)	1. Text: Houghton-Mifflin. 2. Applications in Math, by Johnson, et.al. Publ. Scott Foresman.

Problem: The Ace Carton Company wanted to produce boxes to hold 1728 cubic inches of goods using the least amount of cardboard. A bonus was offered to the employee who designed the best one.

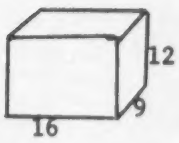
BOX	A	B	C	D	E	F	G
Area Front							
Area Back							
Area Top							
Area Base							
Area Left End							
Area Right End							
TOTAL AREA							
VOLUME							

PROBLEM continued

A



B



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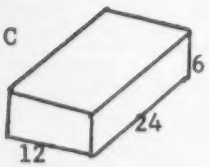
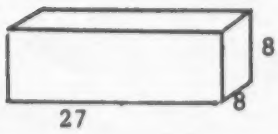
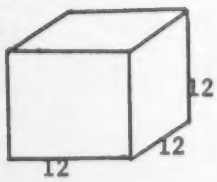


D



E



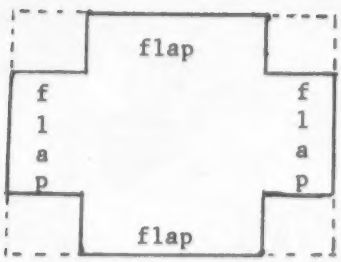
F

G

Side of torn-off corner square (units)	Length (Units)	Width (Units)	Height (Units)	Volume (Cu.Units)

This project could also be done by giving each member of the class a rectangular sheet of paper and just telling them to make a box by cutting out square corners. Tell them to find the size of the square cut-out and the volume of the box. Tabulate the class results on the board and discuss where the largest volume occurs.

Note: In tabulating the students' results, the teacher should try to order the results going from the smallest cut to the largest.



Fold flaps up to form sides of the box.

XXXVI.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Volume

DEVELOPMENTAL AREA: Decision Making, Economics

INSTRUCTIONAL GOAL: to find the volume of a right rectangular prism.

DEVELOPMENTAL GOAL: to develop decision making ability.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Find the volume of a right rectangular prism. 2. Recognize that one method of decision making is trial and error.	1. Work problems such as on p.592 of text. 2. Form groups. Give each group several rectangular sheets of paper. Tell them to cut out corner squares and fold up the sides to make a box. Find the volume of the box and then try to make a box with the greatest volume. Have group divide up jobs in solution of problem -- cutting, finding volume, finding dimensions, filling out chart. (attached problem)	1. Text: Houghton-Mifflin. 2. Paper, scissors. 3. Calculus teacher to show mathematical solution to this problem.

XXXVII.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Prisms, Regular Polyhedra, Space Figures

DEVELOPMENTAL AREA: Decision Making, World of Work, Self

INSTRUCTIONAL GOAL: to identify and sketch a prism and to find its surface area and volume.

DEVELOPMENTAL GOAL: to recognize how polyhedra play a part in our everyday life. To appreciate the influence socio-economic and personality factors have on the individual.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Identify and sketch different kinds of prisms. 2. Find the surface area & volume of several prisms. 3. Construct models of two regular polyhedrons. 4. Recognize the importance of regular polyhedra in various fields of work, nature and history. 5. Recognize that the regular polyhedron represents a 3-dimensional figure and we live in a 3-dimensional world. Discuss those factors (personality, socio-economic, etc.) which influence their becoming a "whole person" and playing a positive role in the make-up of their society.	1. Work traditional problems involving sketching and finding area and volume of different types of prisms. 2. Complete a worksheet on how various regular polyhedra are constructed in groups of two or three. (attached worksheet) 3. Construct models of the tetrahedron, dodecahedron, and the icosahedron. (attached worksheet) 4. Discuss with students application and appearances of polyhedra in history (pyramids), in nature, chemistry (crystals), aerospace, and construction technology. Have them give other examples. (See attached sheet for ideas)	1. Problems from Holt, Geometry. 2. Duplicates of worksheets on polyhedra. 3. Tracing paper. 4. Compass, straightedge. 5. Stiff paper (construction). 6. Rubber bands. 7. Scissors. 8. 4 x 6 cards. 9. Scotch tape. 10. Thread. 11. Jacobs: Mathematics A Human Endeavor, W. H. Freeman, pp. 212-218.

Prisms, Regular Polyhedra, Space Figures (continued)

Performance Objective	Activities	Resource Materials
	5. Describe those factors which will influence the development of the "whole person". (e.g., socio-economic, cultural.)	

XXXVIII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Volume of Rectangular Solid and Volume of Pyramid

DEVELOPMENTAL AREA: Education and Training, World of Work

INSTRUCTIONAL GOAL: to compute volume of rectagular solid and volume of pyramid.

DEVELOPMENTAL GOAL: to apply the instructional goal to architecture.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Solve problems for volume of rectangular solid and volume of pyramid. 2. See how this applies in architecture. 3. See that post high school education is necessary.	1. Do few examples from text, p.592 and p.596. 2. Discuss the specific problem below for architecture. 3. Get a GIS printout on Architect.	1. Text: Houghton-Mifflin. 2. Geometry in Occupations by William Fessenden. Publ. J. Walch. 3. Computer terminal.

Problem: Your job as an architect is to compute the volume of air contained in a building and then buy an air conditioner large enough to cool the whole plant. The building is rectangular in shape with length 130 ft., and width 42 ft. The peak of the triangular roof is 15 ft. from the ground and the eaves are 9-1/2 ft. above the ground.

Solution: a. Find volume of lower section: $130 \times 42 \times 9\text{-}1/2 = 51{,}870$

b. Find volume of upper section: $1/2\ [42 \times (15 - 9\text{-}1/2) \times 130] = 15{,}015$

c. Add: $51{,}870 + 15{,}015 = 66{,}885$ cu. ft.

XXXIX.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Area of Circle

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to compute the area of a circle using the formula

$$A = \pi r^2$$

DEVELOPMENTAL GOAL: to see the need for plumbers to be able to find the area of a cross-section of a piece of pipe.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Work elementary problems finding area.	1. Worksheet.
1. Compute the area of a circle given sufficient information.	2. Work problems finding radius of a circle given the area.	
2. Given area, find radius.	3. Find the total surface area of a tin can.	
3. Compute total surface area of a tin can.	4. Discuss how the plumber uses the area formula.	
4. List examples of uses a plumber may have for finding area of a circle.	5. Work problem on attached worksheet.	
5. Work practical problems where proper size pipe must be determined to do a particular job.		

EXAMPLE FOR ACTIVITY #5

A plumber installs pipes and fixtures in gas and water systems. He is usually well paid for his services because his skills are in great demand. To learn this trade, most of our nation's plumbers have spent up to five years as apprentices. This means that they work along with experienced journeymen, and go to school one to three nights a week.

You are a journeyman plumber and have been called in by an industrial concern whose water tank is now fed by three pipes: one 6 inches in diameter, one 16 inches in diameter and one 20 inches in diameter. The 16 inch pipe never exceeds 3/4 capacity, and the 20 inch pipe is rarely 1/2 full. The smallest pipe usually carries close to capacity. The company manager wants to replace these 3 pipes with one sufficient to do the job. What should be the diameter of the single pipe?

Assuming the area of the cross section of each pipe that is used is proportional to the amount of water needed to feed the tank, a solution of the problem would be to find the diameter of a pipe which has a cross section of sufficient area.

Solution:

Pipe 1 $\quad A = \pi r^2 = \pi (3)^2 = 9\pi$

Pipe 2 $\quad \pi (8)^2 \frac{3}{4} = 48\pi$

Pipe 3 $\quad \pi (10)^2 \frac{1}{2} = 50\pi$

Total area needed $= 107\pi$

$$\pi r^2 = 107\pi$$

$$r^2 = 107$$

$$r = \sqrt{107}$$

$$r \approx 10.34$$

Diameter of the needed pipe is about 21 inches.

XL.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Volume of Cone and Cylinder

DEVELOPMENTAL AREA: Economics

INSTRUCTIONAL GOAL: to apply formulas for volume of cylinder & cone.

DEVELOPMENTAL GOAL: to understand the job of a cost estimator.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Apply formulas for volume of cylinder and cone given specific dimensions. 2. Apply formulas for volume of cylinder and cone to life situations.	1. Use specific examples from text, p.598-600. 2. Work accompanying specific problem.	1. Text: Houghton-Mifflin. 2. Supplemental problems, Geometry in Occupations, Pulb. Walch.

Specific Problem:

You are a cost estimator for Snodgrass Industries. Find the cost of 10,000 rivets--special order. The body of the rivet is to be a cylinder, 5-1/8 in. long, with a diameter of 1¼ in. The head of the rivet is a regular cone with a height of 1-1/16 in. and a diameter of 2¼ in. A cubic inch of steel weighs .2816 pounds, and a ton of steel costs Snodgrass $240.00. To get the final sales price for the whole job, add 21% for overhead and profit.

Cost Estimator

Volume of a Cone = $1/3 \left(\frac{\pi}{4} d^2 h\right)$

$$V = 1/3 \times \frac{3.1416}{4} \times (2.25)^2 \times 1.062$$

$$V = 1.408 \text{ cu.in.}$$

Volume of a Cylinder = $\frac{\pi}{4} d^2 h$

$$V = \frac{3.1416}{4} (1.25)^2 \times 5.125$$

$$V = 6.290 \text{ cu.in.}$$

$(1.408 + 6.290) \times .2816 = 2.168$ lbs. p/rivet

$(10{,}000 \times 2.168) \times \frac{240}{2{,}000} = \$2{,}601.60$

$\$2{,}601.60 \times 21\% = \$546.34$

TOTAL PRICE = $3,147.94

XLI.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Volume of a Right Circular Cylinder

DEVELOPMENTAL AREA: World of Work

INSTRUCTIONAL GOAL: to find the volume of a right circular cylinder.

DEVELOPMENTAL GOAL: to relate this to the work of a forester.

Performance Objective	Activities	Resource Materials
The student should be able to:	1. Do some exercises from text, p.598-599.	1. Text: Houghton-Mifflin.
1. Compute volume of right circular cylinder.	2. Estimate the number of board feet in a tree.	2. Geometry in Occupations, by William Fessenden, Publ. J. Walch.
2. See how the forester can determine the number of board feet in a tree.	3. Do specific problem below.	

Problem: Imagine you are a forester and that you have just felled a tree 100 ft. in length. Its diameter is 26 in. thick at 50 ft. from the base. All limbs have been removed. How many board feet are contained in this tree? (A board foot has 144 cubic inches.)

Solution: $V = 3.1416 \times [(13 \text{ in.})^2 \times (100 \times 12 \text{ in.})]$

$V = 3.1416 \times 202{,}800 \text{ cu. in.}$

$V = 3.1416 \times (202{,}800 \div 144)$

$V = 3.1416 \times 1408.3$

$V = 4424.4198 \text{ cu. ft.}$

XLII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Volume of Sphere and Right Circular Cylinder

DEVELOPMENTAL AREA: Economics

INSTRUCTIONAL GOAL: to compute volume of sphere and volume of right circular cylinder.

DEVELOPMENTAL GOAL: to help the student see himself as a consumer and a producer.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Find the volume of a sphere and right circular cylinder. 2. Relate this to economics as a consumer by naming the cylindrical and spherical objects in the home. 3. Cylindrical cans vs. square tin cans. Cylindrical homes vs. square homes. Cylindrical apartment buildings vs. rectangular apartment buildings.	1. Use examples from text, pp.603-604 and pp.598-599. 2. Do problems 4 & 6 p.610 in text. 3. Compare the volumes of cylindrical objects vs. square objects; e.g., (a) cans (b) homes (c) apartment buildings.	1. Text: Houghton-Mifflin.

XLIII.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Measurement: Metric System

DEVELOPMENTAL AREA: Economics

INSTRUCTIONAL GOAL: to learn the basic units of the metric system.

DEVELOPMENTAL GOAL: to develop an appreciation for the economics involved in a change from English to metric units.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Define by a comparison or body reference the basic metric units. 2. List as many changes that will occur in industry, schools, everyday life, by adopting the metric system.	1. Use metric measuring devices to measure some common things such as a person's height, weight and temperature. 2. List changeovers in industry, schools, etc., and the economic impact of each as a result of the adoption of the metric system.	1. Articles students find which are measured, packaged in metric units. 2. The International (SI) Metric System and How It Works, Robert Hopkins, Polymetric Services. 3. Film, "The Metric System" The Universal Language of Measurement, Pathescope Educational Films, Inc.

XLIV.

SUBJECT: Geometry (A) - Grades 9-10

INSTRUCTIONAL TOPIC: Vectors

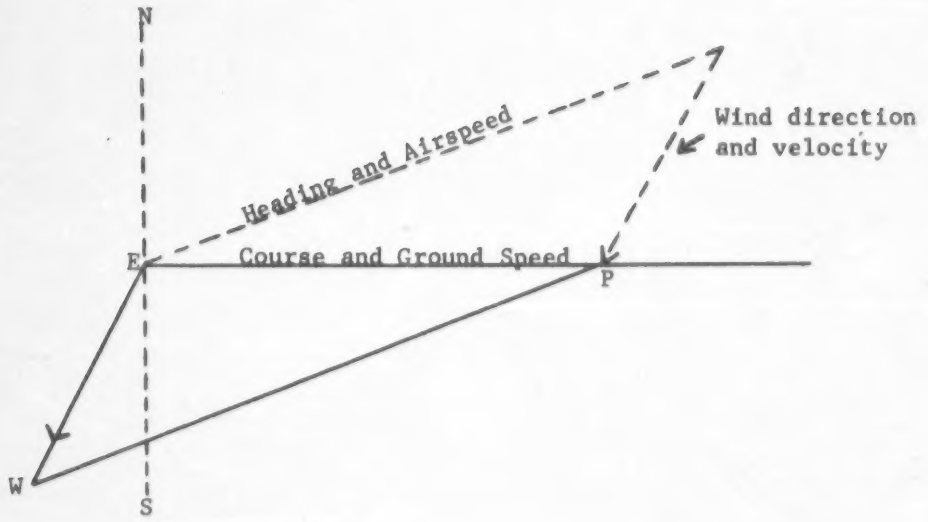
DEVELOPMENTAL AREA: Education and Training, World of Work

INSTRUCTIONAL GOAL: to work with vectors and find the sum of vectors.

DEVELOPMENTAL GOAL: to see how vectors aid the pilot.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Use coordinate axes and draw arrows to represent a vector given as an ordered pair. 2. Find the sum of two vectors. 3. Understand magnitude & direction. 4. Appreciate the pilot's use of vectors in navigation.	1. Work problems like #1 and #3, p.505 of text. 2. Work example from Private Pilot's Handbook. (attached example)	1. Text: Houghton-Mifflin. 2. Private Pilot's Handbook, Federal Aviation Agency, Superintendent of Documents, U.S. Government Printing Office.

THE WIND TRIANGLE: (Graphical representation of the effect of wind upon flight)



1. Each line represents direction and speed.

2. The long dashed line shows the direction the plane is heading, and its length represents the airspeed for 1 hour.

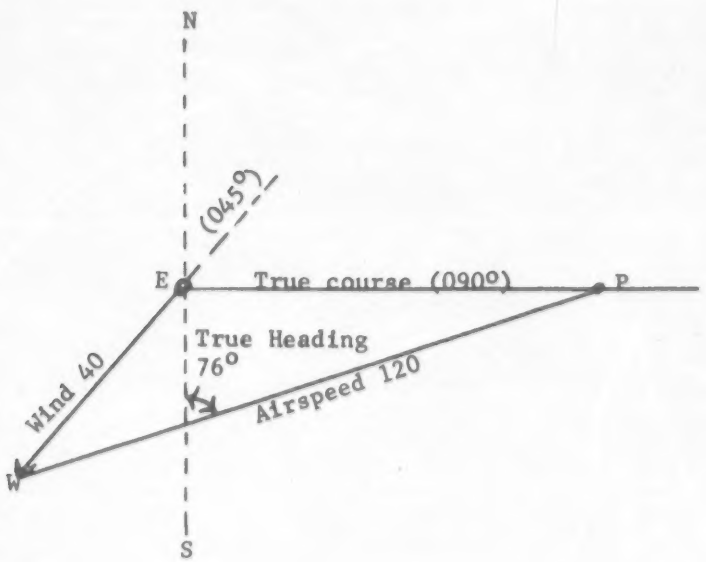
3. Short dashed line is the wind direction, and its length is the wind velocity for 1 hour.

4. The horizontal solid line shows the direction of the track, or the path of the airplane measured over the ground, and its length represents the distance traveled in 1 hour or the ground speed.

5. In actual practice, we construct a similar triangle as shown by the solid line.

WIND TRIANGLE PROBLEM:

We wish to fly from E to P, the true course is due east (090°). We learn from the Weather Bureau that the weather is favorable and the wind at the altitude we intend to fly is 35 knots (40 mph) from the northeast (045°). Our normal airspeed is 120 mph.



1. E (Point of departure).
2. EW is drawn 40 units long corresponding to wind velocity of 40 mph.
3. Draw a line from W intersecting the true course line. The line drawn should be 120 units long corresponding to the airspeed of 120 mph.
4. Point P represents the position of the plane at the end of one hour.
5. The distance flown in one hour (ground speed) is measured as the number of units on the true course line (88 mph).
6. The true heading necessary to offset drift is indicated by the direction of the airspeed line. Place the straight side of the protractor along the north-south line, with its center point at the intersection of the airspeed line and north-south line, we read the true heading in degrees (076°).

XLV.

SUBJECT: Introductory Geometry - Grade 10

INSTRUCTIONAL TOPIC: Reflections, Flips

DEVELOPMENTAL AREA: Employability & Work Adjustment Skills, World of Work

INSTRUCTIONAL GOAL: to perform reflections and flips on given figures.

DEVELOPMENTAL GOAL: to develop positive work habits for working with others. To apply reflections in the world of work.

Performance Objective	Activities	Resource Materials
The student should be able to: 1. Perform elementary flips using tracing paper. 2. Find a line of reflection (flipline) when the original and image are given. 3. Work successfully in pairs performing a given task as part of a team. 4. See how reflections are used in printing. 5. Recognize that some jobs can become obsolete through progress.	1. Work out of Motion Geometry book where available. 2. Work problems in text on reflections and flips. 3. Have the student research and report on the principles of printing and how this is related to reflections. 4. Have students take the role of typesetter and work in pairs. Have each pair of students set up one paragraph of type. Use paper or cardboard squares for the type. 5. Discuss how typesetting is becoming an obsolete job.	1. Worksheet on Motion Geometry texts. 2. Cardboard or paper squares to make letters for Activity #4. 3. Text: Holt Geometry. 4. School print shop. 5. GIS occupation file.